SECTION 5c - Temporal Lag

TEMPORAL LAG AND RISK

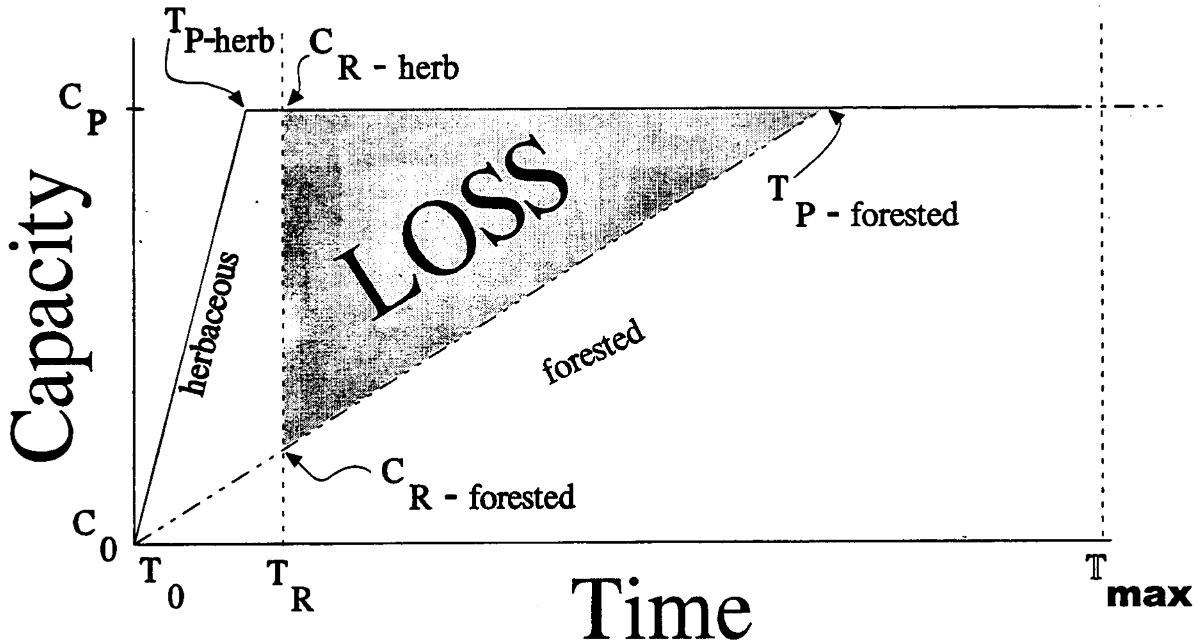
It is known from years of experience that many project specific mitigation plans undertaken by the permittee are fraught with; 1) **uncertainty** regarding the actual functional capacities that a mitigation project will ultimately achieve, 2) **risk** that the mitigation will in fact reach the predicted capacities within the predicted timeframe, and 3) **temporal losses** in wetland function resulting from the time lag between the elimination of the functions at the impact site and the gain in functions at the mitigation site. Typically, uncertainty, risk, and temporal losses have been accounted for in the determination of acreage based compensatory mitigation ratios.

In a mitigation bank however, uncertainty is reduced because the banker is assumed to be a wetland expert who has an incentive to ensure project success. Risk is reduced because credits are released in accordance with a performance based schedule (i.e., most of the credits are not released until the mitigation work has met success criteria). Risk is also attenuated by the required financial assurances. Nevertheless, it must be recognized that there is still some risk involved in mitigation banking. Short-term temporal losses in wetland function are also controlled, for the most part, though the credit release schedule. However, long-term temporal losses arise when the mitigation activity has a maturation period longer than the credit release schedule. This could be dealt with by extending the credit release schedule so that it coincides with the long-term maturation period, but a credit release schedule in excess of 10-years is not practical. This leaves long-term temporal losses and the, albeit reduced, uncertainty and risk unaccounted for.

Instead of taking the traditional approach of applying a ratio at the time credits are debited, it is more appropriate to "adjust" the bank credits for the long-term temporal losses, uncertainty and risk at the time they are awarded. This should help streamline the impact permit evaluation process. To account for these concerns, temporal lag (T) and risk (R) factors are included in the overall credit/debit formula. The T- and R- factors are based on work done by King et al (See Appendix F).

Risk. There has been and continues to be considerable discussion on a uniform guide to assign a score from 0.0 to 1.0 for risk (with 1.0 representing 100% likelihood that the anticipated stream of benefits will be received, or zero risk of failure). Administrative constraints on mitigation banks reduce noncompliance. Risk will usually be zero or minimal. However, a risk factor other than 1.0 can be assigned for most mitigation work that takes place outside of the bank administrative framework. The risk factor acts as a multiplier to the number of units that would be released. For example, with a risk of 10% failure, R = 0.90, and the number of units that would otherwise be released would be multiplied by 0.90. In addition, risk will typically vary by wetland function. For example, for a particular mitigation site, the risk of hydrologic improvement failing may be low but the risk of that wildlife improvements reach full success may be high if there are a large number of potential adjacent land-use influences beyond the control of the site manager. A detailed method for derivation of a risk percentage or multiplier will soon be available for review.

Temporal Lag Factor -The T-factor is essentially a present worth calculation intended to reconcile the streams of lost benefits from the wetlands degraded or lost at the impact site with those gained at the bank. The formula involves three periods of time in the life of a mitigation bank. Consider the following graph which plots the functional capacity against the maturation period for two different created wetlands.

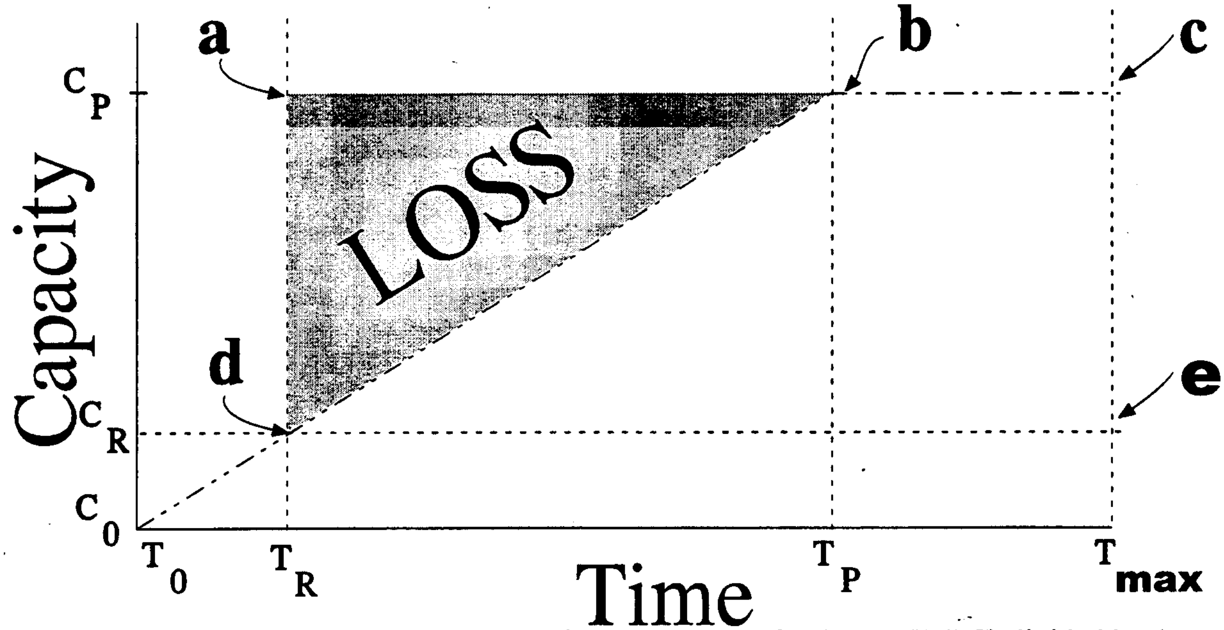


T_0 = Begin construction of the bank.
T_R = End of the credit relapse schedule period.
T_P = The time it takes to reach C_P.
T_{MAX} = Planning horizon.
C_0 = Capacity at T_0 (i.e., existing conditions).
C_P = Predicted Capacity (i.e., with-bank).
C_R = Capacity at T_R (i.e., expected capacity when all credits have been released.

In this example, the herbaceous wetland reaches maturity at $T_{P\text{-herbaceous}}$ before the end of the credit release schedule at T_R. This means all the herbaceous credits can be released for debiting at the same rate C_P is achieved, thereby preventing any temporal lag. The number of credits released at time T_R could be calculated as Units = ($C_{R\text{-herb}}$ - Co) * $\text{Acres}_{\text{herbaceous}}$. ("*" means to multiply.) In the case of the forested wetland however, $T_{P\text{-forested}}$ is not achieved until long after T_R.

The shaded area represents the stream of lost benefits. The shaded area represents the <u>difference</u> between: (1) the stream of benefits that would have been received from the forested area from time T_R to time T_P if the forested area had fully matured at time the credits were released; and, (2) the stream of benefits actually received from the forested wetland. <u>If this loss was ignored</u>, the number of credits released at time T_R would be calculated as Units = (C_P - Co) *

$Acres_{forested}$. Instead, a Temporal Factor (T1) will be used to adjust the number of units as a result of the loss: Units = $[(C_P - C_{R\text{-forested}}) * T1 * Acres_{forested}] + [(C_{R\text{-forested}} - Co) * Acres_{forested}]$. Note that the units earned prior to the date of the credit release are not reduced by the T1 factor.



The T1 factor is therefore calculated as a ratio. T1 = (area of polygon EDBC) divided by (area of polygon EDAC). Points C are located at Tmax, the planning horizon for the calculation of the stream of benefits. However, as described by King, et al. the benefits lost in the years closer to the time of credit release (T_R) are not equal to the benefits received in later years. Each year's benefits are then "discounted" to an equivalent "Present Worth" (PW) of the benefit, the PW calculated at the year of credit release.

We will use 70 years as the planning horizon (T_{MAX}). This is the period of time over which the benefits lost or gained will be summed. There are many determinants that can be used to set the value of T_{MAX}. However, the primary determinant in this case is a result of the "discounting" of each year's benefits to a "Present Worth". At 7.38% discount rate, a benefit of 1.0000 received in Year 70 has a Present Worth of only 0.0068. Therefore, summing any benefits received after Year 70 will have minimal influence on the calculation of T1 unless we go to a large number of decimals.

The formula found in King et al. performs this calculation. Unfortunately (for us), the formula cannot be used "as-is". First, the formula presumes that the nature of the impact site is known so that the functional capacity of the mitigation site is measured as a percentage of the impact site. However, in the case of mitigation banks, the impact site is not known. Therefore, the equation must be rewritten to express the mitigation site against some absolute functional capacity scale from 0.0 to 1.0. Second, the formula results in a ratio of acres of a single polygon of mitigation required to balance the stream of benefits from a single polygon of impact. In the case of a bank, there may be multiple polygons, for example, one of herbaceous wetland and another of forested wetland, and the accounting of multiple ratios would quickly become cumbersome. For day to day use, a T1 factor table has been prepared rather than requiring calculation each time. To understand how the table was derived, please refer to Appendix F.

The following table provides the T factor for varying circumstances.

YS = Year Start. (a) If the construction and planting activities for the polygon commence within the credit release year (T_R), then YS = 1. (b) If the construction and planting activities for the polygon commence prior to the credit release year (T_R), then YS = -1 if one year prior, -2 if two years prior, etc. (c) The values for YS = +2, +3, +4 and +5 are included in the table generally for convenience of those who will be using the T factor for non-mitigation-bank projects, where the individual circumstances (such as construction timing) warrant initiation of mitigation work after the date of impact. YS = 1 + the number of years after the year of impact. For example, if the impact occurs in year 2 but the mitigation is phased to start construction in year 3, then YS = 2).

YF = Year Finish. If the mitigation polygon is expected to reach full maturity within or before the credit release year (T_R), then YF = 1. Full maturity is that functional capacity that is expected to be maintained by the management practices for the planning horizon, 70 years. If the polygon will reach full maturity after the credit release year (T_R), then YF = 1 + the number of years after credit release (for example, if the credits are released in year 5 but the mitigation is expected not to be mature until year 40, then YF = 35).

For application of the T-factor to mitigation banks, the year of "credit release" will actually be the end of the anticipated credit release schedule.

(Table found on following pages)

YS		YF= 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
YS=																
-1	T=	1.0000	0.977	0.949	0.921	0.892	0.865	0.838	0.812	0.787	0.763	0.740	0.718	0.697	0.676	0.657
-2	T=	1.0000	0.983	0.959	0.934	0.908	0.881	0.856	0.831	0.806	0.783	0.760	0.738	0.717	0.697	0.677
-3	T=	1.0000	0.986	0.966	0.943	0.919	0.895	0.870	0.846	0.822	0.799	0.777	0.756	0.735	0.715	0.695
-4	T=	1.0000	0.988	0.971	0.950	0.928	0.905	0.882	0.859	0.836	0.814	0.792	0.771	0.750	0.730	0.711
-5	T=	1.0000	0.990	0.975	0.956	0.935	0.914	0.892	0.870	0.848	0.826	0.805	0.784	0.764	0.745	0.726
1	T=	1.0000	0.9654	0.9324	0.9008	0.8707	0.8420	0.8145	0.7884	0.7632	0.7393	0.7164	0.6945	0.6735	0.6534	0.6341
2	T=		0.9308	0.8985	0.8678	0.8384	0.8104	0.7836	0.7580	0.7337	0.7102	0.6880	0.6667	0.6463	0.6267	0.6080
3	T=			0.8663	0.8363	0.8077	0.7803	0.7542	0.7292	0.7054	0.6828	0.6609	0.6403	0.6204	0.6014	0.5832
4	T=				0.8062	0.7783	0.7517	0.7367	0.7018	0.6786	0.6564	0.6354	0.6150	0.5958	0.5773	0.5596
5	T=					0.7503	0.7243	0.6996	0.6757	0.6531	0.6315	0.6108	0.5913	0.5722	0.5544	0.5371

YS		YF= 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
YS=																
-1	T=	0.638	0.620	0.603	0.587	0.571	0.556	0.541	0.527	0.513	0.500	0.488	0.476	0.464	0.453	0.442
-2	T=	0.658	0.640	0.623	0.606	0.590	0.575	0.560	0.546	0.532	0.519	0.506	0.494	0.482	0.471	0.460
-3	T=	0.676	0.658	0.641	0.624	0.608	0.593	0.578	0.563	0.549	0.536	0.523	0.511	0.499	0.487	0.476
-4	T=	0.693	0.675	0.657	0.641	0.624	0.609	0.594	0.579	0.565	0.552	0.539	0.527	0.514	0.503	0.492
-5	T=	0.707	0.689	0.672	0.656	0.639	0.624	0.609	0.594	0.580	0.567	0.554	0.541	0.529	0.517	0.506
1	T=	0.6157	0.5980	0.5811	0.5649	0.5493	0.5343	0.5200	0.5062	0.4930	0.4803	0.4681	0.4564	0.4451	0.4342	0.4238
2	T=	0.5901	0.5729	0.5565	0.5407	0.5256	0.5111	0.4971	0.4838	0.4710	0.4587	0.4468	0.4355	0.4245	0.4140	0.4039
3	T=	0.5657	0.5491	0.5331	0.5177	0.5031	0.4890	0.4755	0.4625	0.4501	0.4381	0.4267	0.4156	0.4051	0.3949	0.3851
4	T=	0.5426	0.5264	0.5108	0.4960	0.4817	0.4680	0.4549	0.4423	0.4302	0.4187	0.4075	0.3969	0.3866	0.3767	0.3673
5	T=	0.5206	0.5049	0.4897	0.4882	0.4614	0.4481	0.4354	0.4232	0.4114	0.4002	0.3894	0.3791	0.3691	0.3596	0.3504

YS		YF= 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
YS=																
-1	T=	0.432	0.422	0.413	0.403	0.394	0.386	0.377	0.369	0.362	0.354					
-2	T=	0.449	0.439	0.429	0.420	0.411	0.402	0.393	0.385	0.377						
-3	T=	0.465	0.455	0.445	0.436	0.426	0.417	0.409	0.400							
-4	T=	0.481	0.470	0.460	0.450	0.441	0.432	0.423								
-5	T=	0.495	0.485	0.474	0.464	0.455	0.446									
1	T=	0.4137	0.4040	0.3947	0.3857	0.3771	0.3687	0.3607	0.3529	0.3454	0.3381	0.3312				
2	T=	0.3942	0.3848	0.3758	0.3671	0.3587	0.3507	0.3429	0.3354	0.3282	0.3212	0.3144	0.3079			
3	T=	0.3757	0.3666	0.3579	0.3495	0.3414	0.3336	0.3261	0.3189	0.3119	0.3051	0.2986	0.2923	0.2863		
4	T=	0.3581	0.3494	0.3409	0.3328	0.3250	0.3175	0.3102	0.3032	0.2965	0.2900	0.2837	0.2776	0.2718	0.2661	
5	T=	0.3415	0.3331	0.3249	0.3170	0.3095	0.3022	0.2952	0.2884	0.2819	0.2756	0.2696	0.2637	0.2581	0.2526	0.2474

(Table continues next page)

YS=	YF=	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
-1	T=	0.340	0.333	0.327	0.320	0.314	0.308	0.302	0.297	0.292	0.287	0.282	0.277	0.272	0.267	0.263
-2	T=		0.332	0.326	0.320	0.314	0.308	0.302	0.296	0.291	0.286	0.281	0.276	0.272	0.267	0.263
-3	T=			0.326	0.320	0.314	0.308	0.302	0.297	0.291	0.286	0.281	0.277	0.272	0.267	0.263
-4	T=				0.321	0.315	0.309	0.303	0.298	0.292	0.287	0.282	0.277	0.273	0.268	0.264
-5	T=					0.316	0.310	0.305	0.299	0.294	0.289	0.284	0.279	0.274	0.270	0.265
1	T=	0.3241	0.3175	0.3116	0.3051	0.2992	0.2935	0.2880	0.2830	0.2774	0.2728	0.2679	0.2632	0.2586	0.2542	0.2499
2	T=		0.3013	0.2952	0.2897	0.2837	0.2781	0.2728	0.2677	0.2630	0.2578	0.2535	0.2490	0.2446	0.2404	0.2362
3	T=			0.2801	0.2744	0.2693	0.2636	0.2585	0.2535	0.2488	0.2445	0.2396	0.2356	0.2314	0.2273	0.2234
4	T=				0.2603	0.2550	0.2503	0.2450	0.2402	0.2356	0.2311	0.2272	0.2226	0.2190	0.2150	0.2112
5	T=					0.2419	0.2370	0.2326	0.2276	0.2232	0.2189	0.2148	0.2111	0.2068	0.2035	0.1998

YS=	YF=	57	58	59	60	61	62	63	64	65	66	67	68	69	70
-1	T=	0.259	0.254	0.250	0.246	0.243	0.239	0.235	0.232	0.228	0.225	0.222	0.218	0.215	0.212
-2	T=	0.258	0.254	0.250	0.246	0.242	0.238	0.235	0.231	0.228	0.224	0.221	0.218	0.215	0.212
-3	T=	0.259	0.254	0.250	0.246	0.242	0.239	0.235	0.232	0.228	0.225	0.222	0.218	0.215	0.212
-4	T=	0.260	0.255	0.251	0.247	0.243	0.240	0.236	0.233	0.229	0.226	0.222	0.219	0.216	0.213
-5	T=	0.261	0.257	0.253	0.249	0.245	0.241	0.238	0.234	0.231	0.227	0.224	0.221	0.218	0.215
1	T=	0.2457	0.2416	0.2377	0.2339	0.2302	0.2265	0.2230	0.2196	0.2163	0.2131	0.2099	0.2069	0.2039	0.2010
2	T=	0.2322	0.2283	0.2246	0.2209	0.2173	0.2139	0.2105	0.2072	0.2041	0.2010	0.1979	0.1950	0.1922	0.1894
3	T=	0.2195	0.2158	0.2122	0.2087	0.2052	0.2019	0.1987	0.1956	0.1925	0.1896	0.1867	0.1839	0.1811	0.1785
4	T=	0.2075	0.2040	0.2005	0.1971	0.1938	0.1907	0.1876	0.1846	0.1816	0.1788	0.1761	0.1734	0.1708	0.1682
5	T=	0.1962	0.1928	0.1895	0.1862	0.1831	0.1800	0.1771	0.1742	0.1714	0.1687	0.1660	0.1635	0.1610	0.1585

Example: If the banker commences restoration, enhancement, or creation in the first year of bank operation (year 1) with a 5 year credit release schedule (credit release in year 5) and the agreed upon maturation time for the wetland system is 40 years, the T Factor is 0.455. This is found on the table where YS = -5 and YF = 35. YS = -5 because the banker commenced work five years prior to the credit release year. YF = 35 because the wetland matures 40 years after the commencement of the bank operation, but 34 years after the credit release year.